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Analytical investigation of nonlinear interlaminar fracture in trilayered polymer composite beam under mode II crack loading conditions using the J-integral approach. (English)

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Summary: The present study is concerned with a nonlinear fracture analysis of trilayered beam built up by two unidirectional fiber-reinforced polymer composites. It is assumed that two interlaminar cracks exist between the layers. A tensile force applied to the middle layer generates pure mode II crack loading conditions. The J-integral approach is used to investigate the nonlinear fracture behavior of the beam. The elastic-linearly hardening model is applied to describe the mechanical behavior of the two composites. Sixth expressions for J-integral are derived using a beam theory model. These expressions correspond to the characteristic magnitudes of the external force. The validity of the formulae obtained is proved by comparison with the J-integral solution in the case of linear-elastic behavior of the composite materials. A numerical example is presented in order to demonstrate the ability of the expressions obtained for the analysis of nonlinear fracture in polymer composites.

MSC:

74R10 Brittle fracture
74E30 Composite and mixture properties
74B05 Classical linear elasticity
74B20 Nonlinear elasticity

Keywords:

nonlinear fracture behavior; beam theory; polymer composite; J-integral; closed-form analytical solution

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